TM 7558A

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376

TM 7558A

Counter/Timer Function Unit

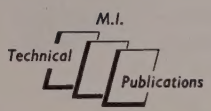
INSTRUCTION MANUAL

MARCONI INSTRUMENTS LIMITED
ST. ALBANS HERTFORDSHIRE ENGLAND

376

INSTRUCTION MANUAL
No. TM 7558A
for

Counter/Timer Function Unit
TM 7558A



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ST. ALBANS HERTFORDSHIRE ENGLAND

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EBM 7558A
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Section I

General information

1.1 INTRODUCTION

The Counter/Timer Function unit, type TM 7558A, is a plug-in unit designed for operation with the TF 2401A Counter and a Range unit.

This Function unit comprises the B and C input amplifiers and the function switch which controls the d. c. signals fed to the gating in the Range unit and basic instrument. When used with these two, the Function unit performs the following basic measurements :-

1. Time interval measurement.
2. Period measurement.
3. Multiple period measurement.
4. Frequency measurement.
5. Frequency ratio of two applied signals.
6. Ratio of one frequency to a multiple of another frequency.
7. Externally applied events during externally applied time interval.
8. Straight or totalizing measurement.
9. Scaling down of an applied signal.

In addition to the above functions there is a self-test position on the function switch for checking the operation of the dividers and decade counting units.

Fig. 1.1 Counter/Timer Function Unit

1.2 DATA SUMMARY

INPUT :	Two channels (B and C).
INPUT SENSITIVITY :	0.1 V r.m.s.
ATTENUATORS :	Factors of 1, 4, 16, 64 and 256, switch selected.
RANGE :	0 c/s to 10 Mc/s, sinewave or pulse; reduced sensitivity below 1 c/s sinewave.
INPUT IMPEDANCE :	Approximately 1 MΩ shunted by 40 pF.
MAX. INPUT LEVEL :	500 V p-p on X256 attenuator setting. 3 V r.m.s. on X1 attenuator setting.
SLOPE SELECTION :	Positive or negative.
TRIGGER LEVEL ERROR : (sinewave)	Single period or frequency ratio : better than 0.3%. Multiple period or multiple frequency ratio : $\frac{0.3\%}{\text{Mult. factor}}$

TIME INTERVAL MEASUREMENT (B→C) :

Start - Stop :	Independent channels.
Range :	0.1 μsec to 10^8 sec when used with 50 Mc/s Range Unit, TM 7557A; p.r.f. must not exceed 10 Mc/s. 0.2 μsec to 10^8 sec when used with 110 Mc/s Range Unit, TM 8267; p.r.f. must not exceed 5 Mc/s.
Accuracy (pulse input) :	±1 count ± time base accuracy.
Standard Frequency Counted :	1 c/s to 10 Mc/s in decade steps for TM 7557A. 1 c/s to 100 Mc/s in decade steps for TM 8267.
Readout :	From basic Counter.

PERIOD MEASUREMENT (PER B) :

Range :	0.1 μsec to 10^8 sec when used with 50 Mc/s Range Unit, TM 7557A. 0.2 μsec to 10^8 sec when used with 110 Mc/s Range Unit, TM 8267.
Accuracy :	±1 count ± time base accuracy ± trigger level error.
Standard Frequency Counted :	1 c/s to 10 Mc/s in decade steps for TM 7557A. 1 c/s to 100 Mc/s in decade steps for TM 8267.
Readout :	From basic Counter.

MULTIPLE PERIOD MEASUREMENT (MULT. PER B) :

Range :	0.1 μsec to 100 sec.
Accuracy :	±1 count ± time base accuracy ± trigger level error.

Standard Frequency Counted :	Select 10 Mc/s or 1 Mc/s.
Period Mult. Factor :	10 to 10^8 in decade steps.
Readout :	From basic Counter.

FREQUENCY MEASUREMENT (FREQ A) :

Input Voltage and Frequency limits :	As for Range unit (A).

FREQUENCY RATIO MEASUREMENT (A/B) :

Higher Frequency :	Applied to Range unit (A). Limits as for Range unit.
Lower Frequency :	Applied to input B; 0.1 μsec to 10^8 sec when used with 50 Mc/s Range Unit, TM 7557A. 0.2 μsec to 10^8 sec when used with 110 Mc/s Range Unit, TM 8267.
Accuracy :	±1 count ± input B trigger level error.

MULTIPLE FREQUENCY RATIO MEASUREMENT (A/MULT. B) :

Higher Frequency :	Applied to Range unit (A); limits as for Range unit.
Lower Frequency :	Applied to input B; limits as for B and C channels.
Accuracy :	±1 count ± trigger level error.
Mult. Factor :	10 to 10^8 in decade steps.

EVENTS PER TIME INTERVAL (A/B⟶C) :

Events :	Applied to Range unit (A). Limits as for Range unit.
Time Interval :	Applied to B and C inputs, as for Time Interval measurements.
Accuracy : (pulse input to B and C)	±1 count.

TOTALIZING MEASUREMENT (COUNT A) :

Count Storage :	Up to 10^8 events.
Input Voltage and Frequency limits :	As for Range unit (A).

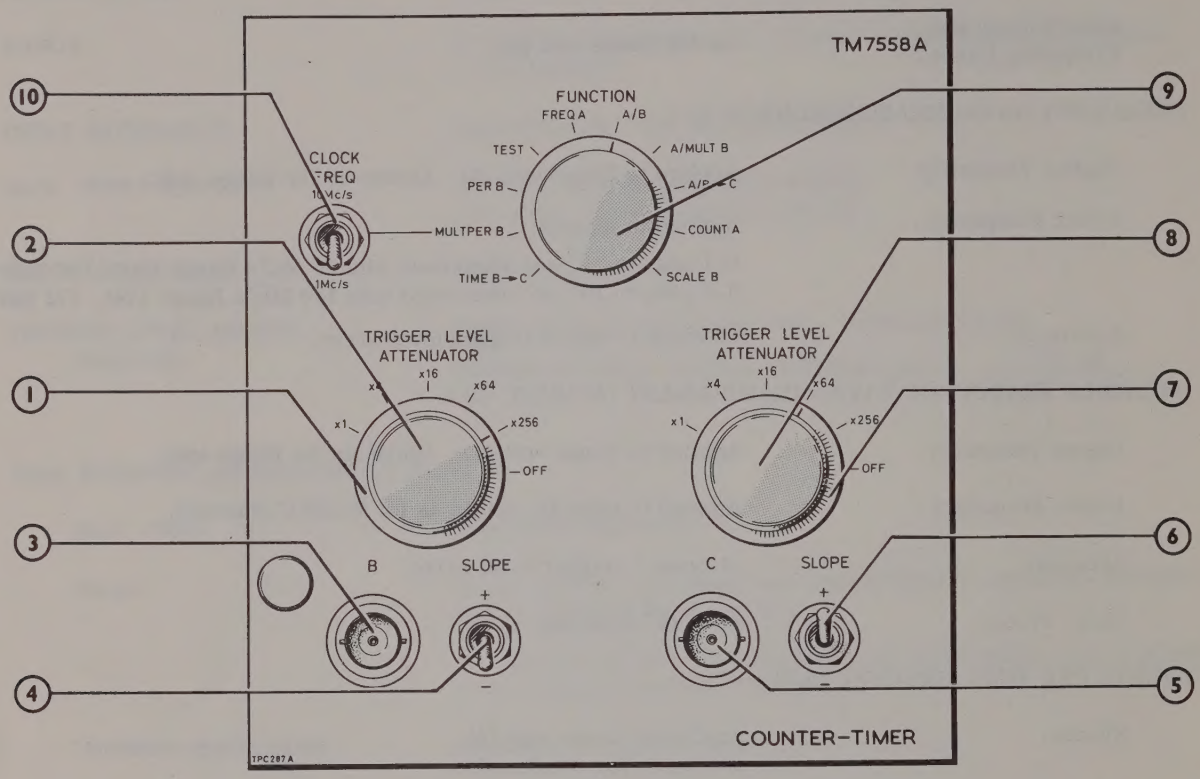
SCALING (SCALE B) :

Input Voltage and Frequency limits :	As for B and C channels.
Division factors :	10 to 10^{16} in decade steps.

ACCESSORIES SUPPLIED : 2 x free plugs, type BNC.

Section 2

Operation



Controls and connectors

2.1 INSTALLATION

The space, in the basic Counter, provided to accept the Function unit is shown on the illustration in the TF 2401A handbook. The unit is easily installed by locating it in its guide channel, and pushing it slowly to the rear of the Counter until it locks with its mating connectors. Once firmly in position secure the unit using the locking screw provided at the front of the unit.

2.2 CONTROLS AND CONNECTORS

(1) B ATTENUATOR switch. Sets the maximum allowable B input signal.

(2) B TRIGGER LEVEL control. Determines the instantaneous voltage of the direct or attenuated input signal which will trigger the B input amplifier.

(3) B Input connector. BNC socket for B input signal.

(4) B SLOPE switch. Determines which slope (positive or negative) of the B input signal will trigger the B input amplifier.

(5) C Input connector. BNC socket for C input signal.

⑥ C SLOPE switch. Determines which slope (positive or negative) of the C input signal will trigger the C input amplifier.

⑦ C ATTENUATOR switch. Sets the maximum allowable C input signal.

⑧ C TRIGGER LEVEL control. Determines the instantaneous voltage for the direct or attenuated input signal which will trigger the C input amplifier.

⑨ FUNCTION switch. Sets the instrument for the desired operating mode.

⑩ CLOCK switch. Selects the frequency to be counted (10 Mc/s or 1 Mc/s) when making multiple period measurements. It is inoperative for all other positions of the FUNCTION switch.

Controls and connectors located on the counter and range unit, are listed in the appropriate handbook.

2.3 CONNECTING INPUTS

Input connections must be shielded, by the use of coaxial cable, to prevent noise pick-up.

2.4 SELF-CHECK TEST

The instrument self-checks the time base and the decade counting units. Following installation, and from time to time, the self-check facility should be employed as follows.

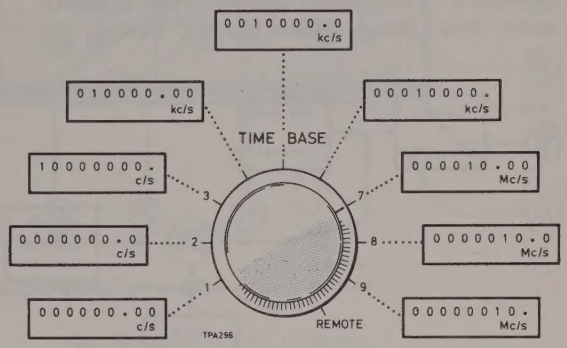


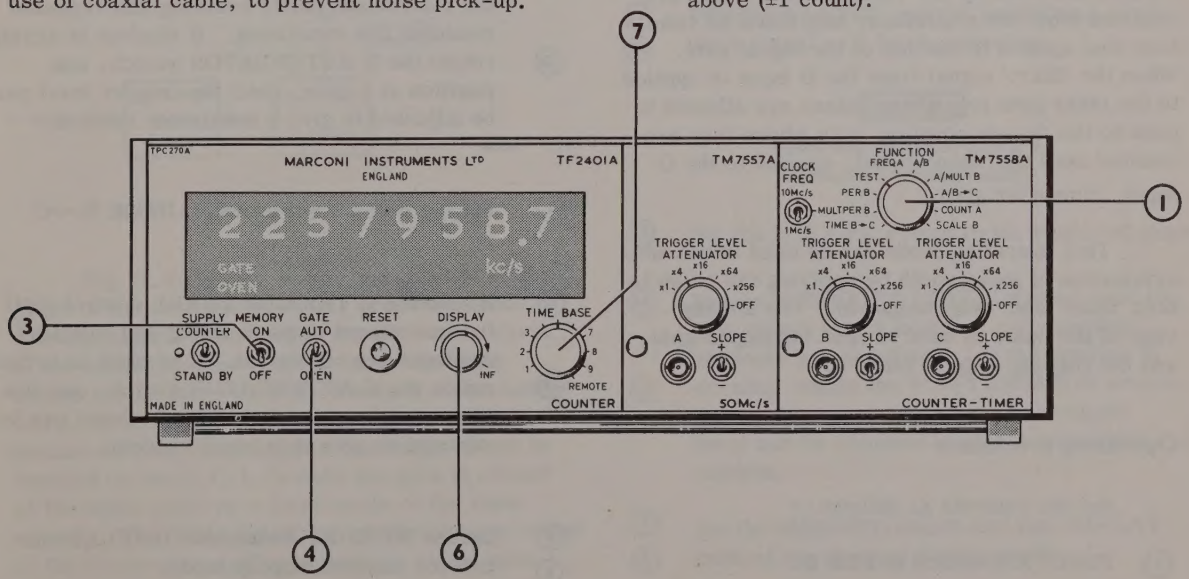
Fig. 2.1 Self-check readout

① Set FUNCTION switch to TEST.

④ Set GATE switch to AUTO.

⑥ ③ Set DISPLAY control and MEMORY switch for desired display mode.

⑦ Rotate TIME BASE switch through its frequency positions and observe the decade readouts, which should be as indicated above (±1 count).



2.5 TIME INTERVAL MEASUREMENT

Functional description

With the FUNCTION switch set to TIME B⟶C the instrument measures the time interval between a 'Start' signal applied to the B Input, and a 'Stop' signal applied to the C Input.

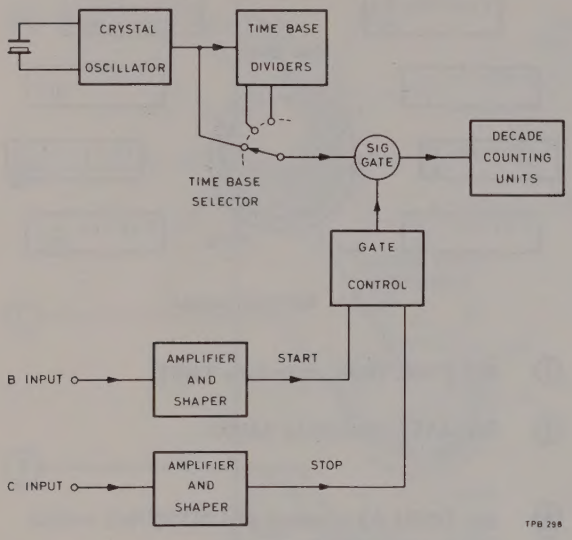


Fig. 2.2 Functional diagram: B⟶C

Fig. 2.2 shows a simplified functional diagram of the instrument in this operating mode. Pulses, selected by the TIME BASE switch, are obtained from the multiplier, oscillator or time base and applied to one leg of the signal gate. When the 'Start' signal from the B Input is applied to the other gate leg, these pulses are allowed to pass to the decade counting units where they are counted until the 'Stop' signal, applied to the C Input, closes the gate.

This operating mode can be used in the determination of pulse width by applying the pulse to both 'Start' and 'Stop' channels. The leading edge of the pulse is used to open the signal gate, and the trailing edge to close it.

Operating procedure

Set the controls as follows :-

(1) FUNCTION switch to PER B.

(7) TIME BASE switch to the centre of its range. Any position may be used after trigger level is set.

(4) GATE switch to AUTO.

(3) MEMORY switch to OFF.

(6) DISPLAY control for short display time.

(13) (17) (14) (18) B and C ATTENUATOR switches to X256 and TRIGGER LEVEL controls to centre.

(12) Apply 'Start' signal to B Input connector.

(16) Apply 'Stop' signal to C Input connector.

CAUTION

Inputs must not exceed 500V p–p on maximum attenuator setting

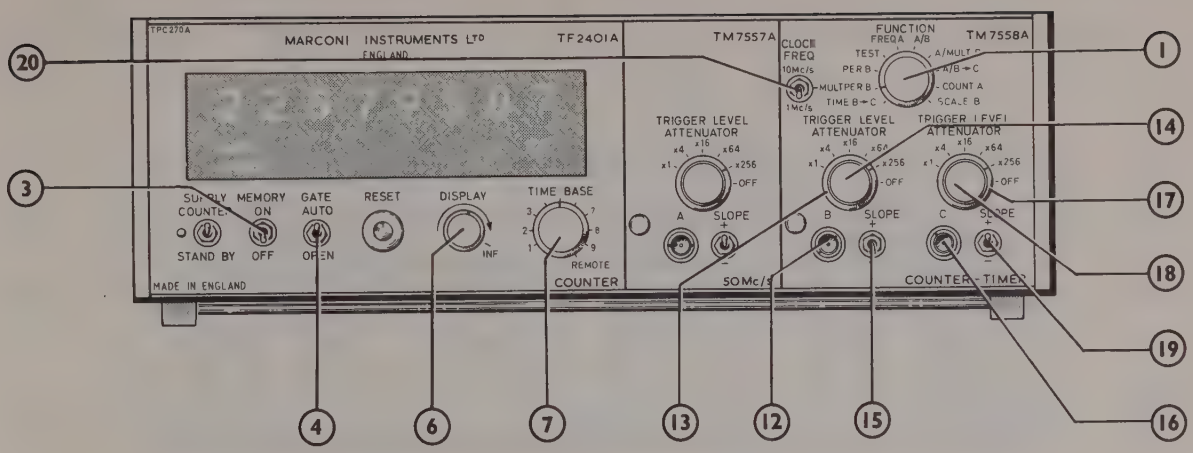
(15) (19) Set the B and C SLOPE switches to the required slope.

(14) (13) Rotate the B TRIGGER LEVEL control until the instrument starts counting and repeated readouts are consistent. If readout is erratic, rotate the B ATTENUATOR switch, one position at a time, until the trigger level can be adjusted to give a consistent readout.

(1) Set the FUNCTION switch to TIME B⟶C.

(18) (17) Rotate the C TRIGGER LEVEL control until the instrument stops counting and repeated readouts are consistent. If readout is erratic, rotate the C ATTENUATOR switch, one position at a time, until the trigger level can be adjusted to give consistent readout.

(3) (6) Set the MEMORY switch and DISPLAY control for desired display mode.



2.6 MULTIPLE PERIOD MEASUREMENT

Functional description

With the FUNCTION switch set to MULT PER B the instrument measures the period of a signal applied to the B input. This FUNCTION switch setting gives greater accuracy in period measurement than the PER B position.

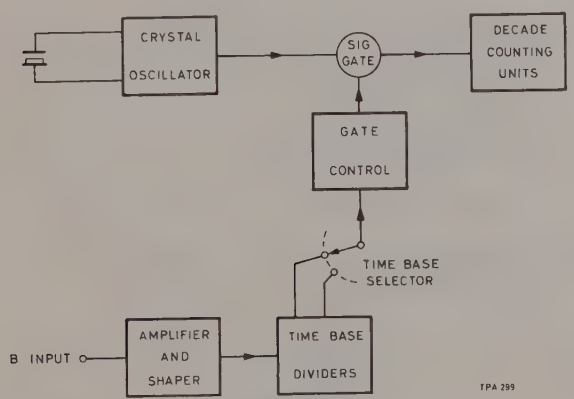


Fig. 2.3 Functional diagram: MULT PER B

Fig. 2.3 shows a simplified functional diagram of the instrument in this operating mode. The signal gate is opened at a point on one cycle of the signal applied to the B input, and this allows the 10 Mc/s or 1 Mc/s output of the oscillator, as selected, to pass through the gate to the decade counting units. The oscillator output is counted by the D. C. U. 's until the gate is closed at the same point on a later cycle of the input signal. The TIME BASE switch determines which of the succeeding cycles closes the signal gate.

Operating procedure

Set the controls as follows :-

(1) FUNCTION switch to MULT PER B.

(7) TIME BASE switch to the desired multiplying factor.

(4) GATE switch to AUTO.

(3) MEMORY switch to OFF.

(20) CLOCK-FREQ switch to desired counting frequency.

(6) DISPLAY control for short display time.

(13) (14) (12) B ATTENUATOR switch to X256 and the TRIGGER LEVEL control to centre. Apply input signal to B Input connector.

CAUTION

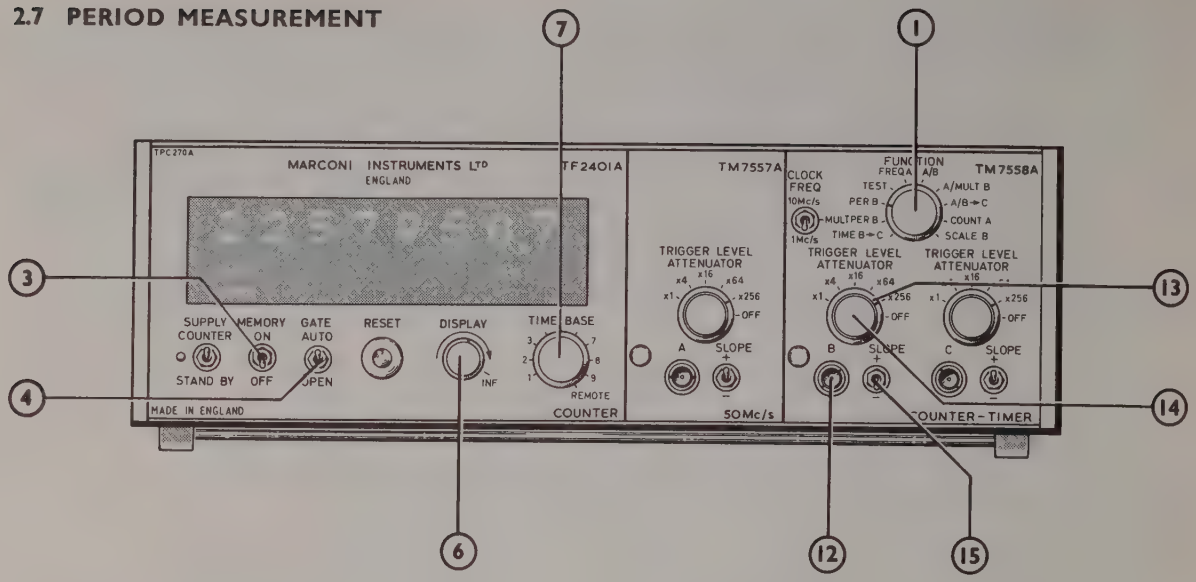
Inputs must not exceed 500V p-p on maximum attenuator setting

(15) Set the B SLOPE switch to the required slope.

(14) (13) Rotate B TRIGGER LEVEL control until the instrument starts counting and repeated readouts are consistent. If the readout is erratic, rotate the B ATTENUATOR switch, one position at a time, until the trigger level can be adjusted to give a consistent readout.

(3) (6) Set the MEMORY switch and the DISPLAY control for desired display mode.

2.7 PERIOD MEASUREMENT



Functional description

With the FUNCTION switch set to PER B the instrument measures the period of one cycle of a signal applied to the B Input.

Fig. 2.4 shows a simplified functional diagram of the instrument in this operating mode. The signal gate is opened at a point on one cycle of the signal applied to the B Input. This allows pulses, selected by the TIME BASE switch, from the multiplier, oscillator or time base to pass through the gate to the decade counting units. These pulses are counted by the D. C. U. 's until the gate is closed at the same point on the next cycle of the input signal.

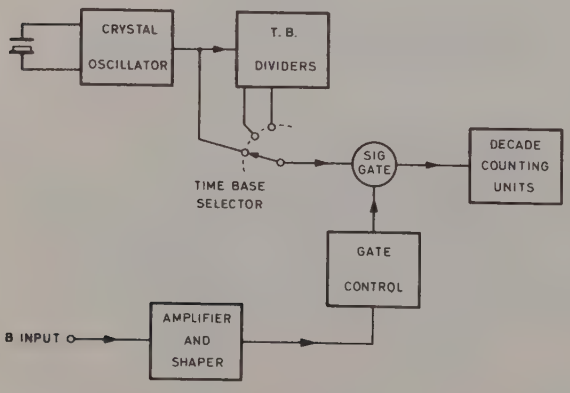


Fig. 2.4 Functional diagram: PER B

Operating procedure

Set the controls as follows :-

(1) FUNCTION switch to PER B.

(7) TIME BASE switch to the desired position.

(4) GATE switch to AUTO.

(3) MEMORY switch to OFF.

(6) DISPLAY control for a short display time.

(13) B ATTENUATOR switch to X256 and B
(14) TRIGGER LEVEL to centre.

(12) Apply input signal to the B Input connector.

CAUTION

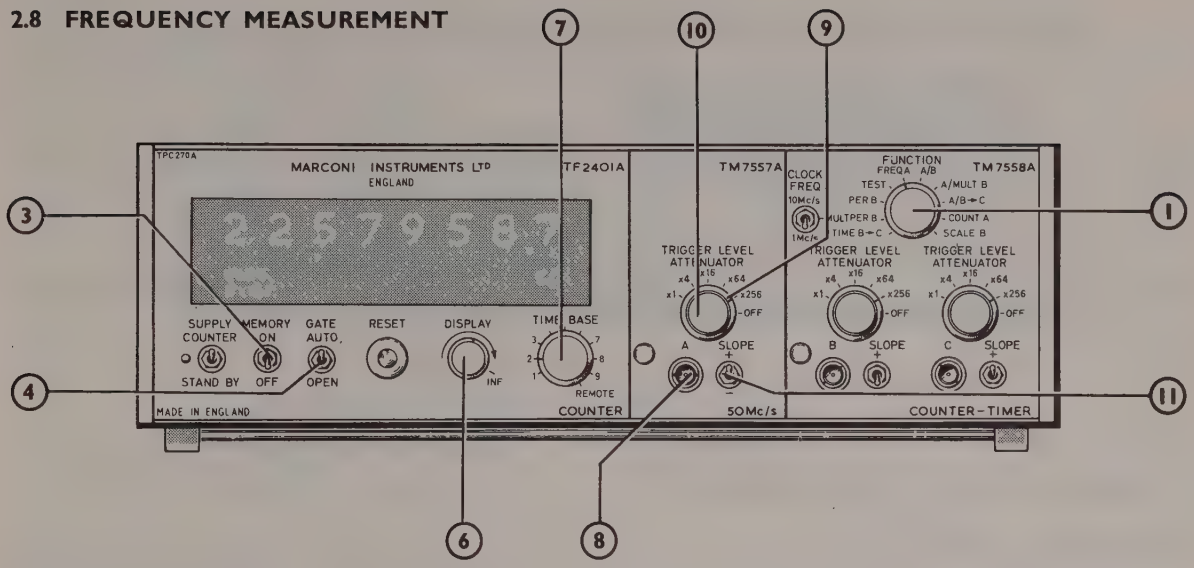
Inputs must not exceed 500V p–p on maximum attenuator setting

(15) Set the B SLOPE switch to the required slope.

(14) Rotate the B TRIGGER LEVEL control until instrument starts counting, and repeated readouts are consistent. If readout is erratic,
(13) rotate B ATTENUATOR switch, one position at a time, until trigger level can be adjusted to give a consistent readout.

(3) Set the MEMORY switch and DISPLAY control
(6) for desired display mode.

2.8 FREQUENCY MEASUREMENT



Functional description

With the FUNCTION switch set to FREQ A, the instrument measures the frequency of a signal applied to the A Input by counting the number of cycles of the input over a selected interval of time.

Fig. 2.5 shows a simplified functional diagram of the instrument in this operating mode. The signal gate is opened and closed by a selected output of the time base as controlled by the TIME BASE switch. During the time that the gate is open, the input signal is passed through the gate to be counted by the decade counting units.

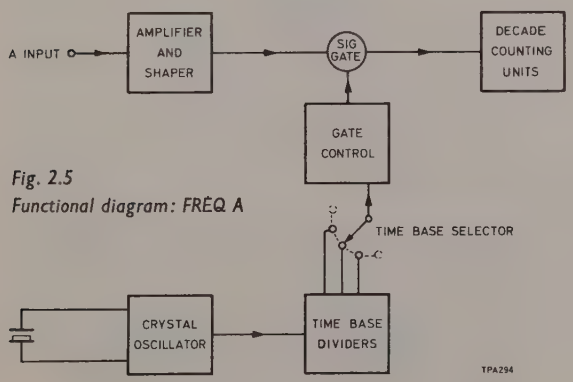


Fig. 2.5
Functional diagram: FREQ A

Operating procedure

Set the controls as follows :-

(1) FUNCTION switch to FREQ A.

(7) TIME BASE switch to the desired position.

(4) GATE switch to AUTO.

(3) MEMORY switch to OFF.

(6) DISPLAY control for a short display time.

(9) A ATTENUATOR to X256 for TM 7557A, or
(10) X100 for TM 8267, and A TRIGGER LEVEL* control to centre.

(11) A SLOPE* switch to the required slope.

(8) Apply the input signal to the A Input connector.

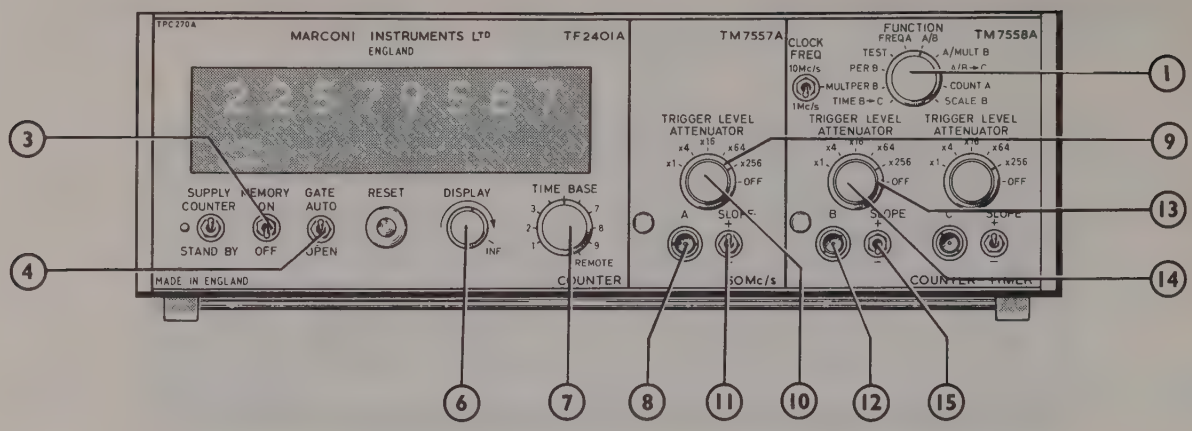
CAUTION

On maximum attenuator setting input must not exceed 500 V p-p for TM 7557A or 100V r.m.s. for TM 8267

(10) Rotate the A TRIGGER LEVEL* control until the instrument starts counting and the readout is consistent. If counting does not start,
(9) rotate the A ATTENUATOR switch, one position at a time, until the trigger level can be set to give a consistent readout.

(3) Set the MEMORY switch and DISPLAY con-
(6) trol for the desired display mode.

* Not applicable to TM 8267 (110 Mc/s Range Unit).



2.9 FREQUENCY RATIO MEASUREMENT

Functional description

With the FUNCTION switch set to A/B the instrument counts the number of cycles of the signal into the A Input for the duration of one cycle of the signal into the B Input.

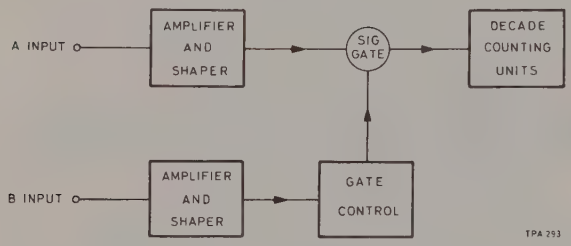


Fig. 2.6 Functional diagram: A/B

Fig. 2.6 shows a simplified functional diagram of the instrument in this operating mode. The signal gate is opened at a point on the first cycle of the signal to the B Input, and closed by the same point on the next cycle. While the gate is open, the signal from the A Input is allowed to pass to, and be counted by, the decade counting units.

In order to obtain a meaningful reading, it is necessary that the frequency of the signal to the A Input is higher than that to the B Input.

Operating procedure

Set the controls as follows :-

(1) FUNCTION switch to FREQ A.

(4) GATE switch to AUTO.

(3) MEMORY switch to OFF.

(6) DISPLAY control for a short display time.

(9) A and B ATTENUATORS to X256 for
(13) TM 7557A, or X100 for TM 8267, and
(10) TRIGGER LEVEL* controls to the centre.
(14)

(8) Apply the signal with the higher frequency to the A Input connector.

(12) Apply the signal with the lower frequency to the B Input connector.

CAUTION

On maximum attenuator setting input must not exceed 500 V p–p for TM 7557A or 100V r.m.s. for TM 8267

(11) Set the A* and B SLOPE switches to the
(15) required slope.

(10) Rotate the A TRIGGER LEVEL* control until the instrument starts counting and the readout is consistent. If counting does not
(9) start, rotate the A ATTENUATOR switch, one position at a time, until the trigger level can be adjusted to give a consistent readout.

(1) Set the FUNCTION switch to PER B. Rotate

* Not applicable to TM 8267 (110 Mc/s Range Unit).

⑭ the B TRIGGER LEVEL control until the instrument starts counting, and repeated readouts are consistent.

⑬ If the readout is erratic, rotate the B ATTENUATOR switch, one position at a time, until the trigger level can be adjusted to give a consistent readout.

① Set the FUNCTION switch to A/B and observe readout.

③ ⑥ Set the MEMORY switch and DISPLAY control for the desired display mode.

2.10 MULTIPLE FREQUENCY RATIO MEASUREMENT

Functional description

With the FUNCTION switch set to A/MULT B the instrument counts the number of cycles of the signal into the A Input for the duration of a selected number of cycles of the signal into the B Input.

Fig. 2.7 shows a simplified functional diagram of the instrument in this operating mode. The signal gate is opened at a point on one cycle of the signal applied to the B Input, and closed by the same point on a subsequent cycle selected by the TIME BASE switch. While the gate is open the signal applied to the A Input is passed to and counted by the decade counting units.

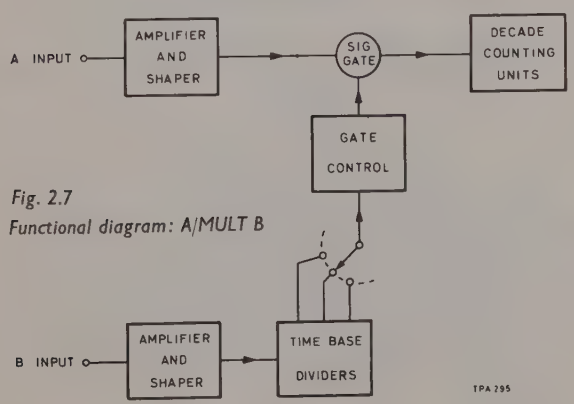


Fig. 2.7
Functional diagram: A/MULT B

Operating procedure

Set the controls as follows :-

⑦ TIME BASE switch to the desired multiplying factor.

① FUNCTION switch to FREQ A.

④ GATE switch to AUTO.

③ MEMORY switch to OFF.

⑥ DISPLAY control for a short display time.

⑨ ⑬ ⑩ ⑭ A and B ATTENUATORS fo X256 for TM 7557A, or X100 for TM 8267, and TRIGGER LEVEL* controls to the centre.

⑧ Apply the signal with the higher frequency to the A Input connector.

⑫ Apply the signal with the lower frequency to the B Input connector.

CAUTION

On maximum attenuator setting input must not exceed 500 V p-p for TM 7557A or 100V r.m.s. for TM 8267

⑪ ⑮ Set the A* and B SLOPE switches to the required slope.

⑩ Rotate the A TRIGGER LEVEL* control until the instrument starts counting, and the readout is consistent. If counting does

⑨ not start, rotate the A ATTENUATOR switch, one position at a time, until the trigger level can be adjusted to give a consistent readout.

① Set the FUNCTION switch to PER B.

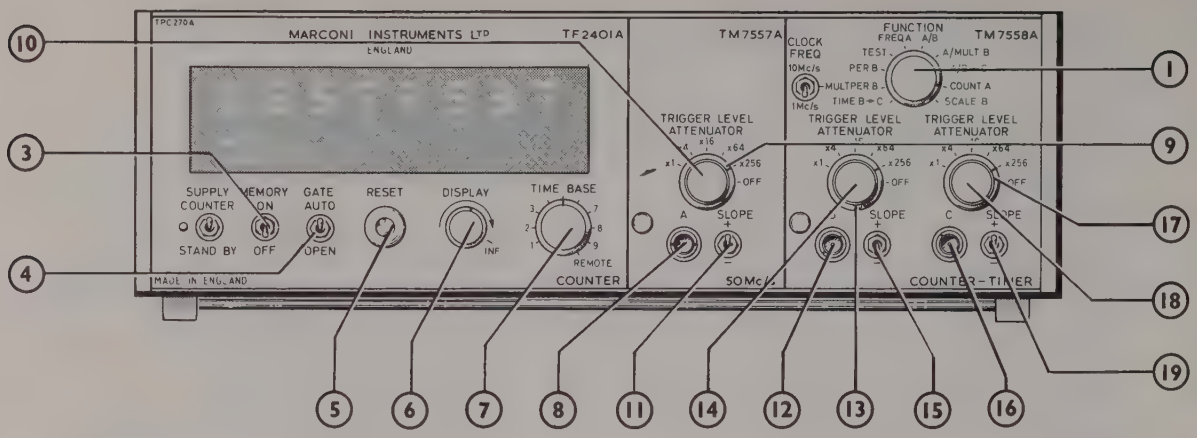
⑭ Rotate the B TRIGGER LEVEL control until the instrument starts counting, and repeated readouts are consistent. If the readout is

⑬ erratic, rotate the B ATTENUATOR switch, one position at a time, until the trigger level can be adjusted to give a consistent readout.

① Set the FUNCTION switch to A/MULT B and observe readout. Divide readout by expansion factor shown in display.

③ ⑥ Set the MEMORY switch and DISPLAY control for desired display mode.

* Not applicable to TM 8267 (110 Mc/s Range Unit).



2.11 MEASUREMENT OF EVENTS DURING A SELECTED TIME INTERVAL

Functional description

With the FUNCTION switch set to A/B→C the instrument measures the number of events (pulse, etc.) which are applied to the A Input, between the time a 'Start' signal is applied to the B Input and a 'Stop' signal is applied to the C Input.

This function may also be used to measure the time interval between two signals, applied to the B and C Inputs, using an external standard as the input to the A amplifier.

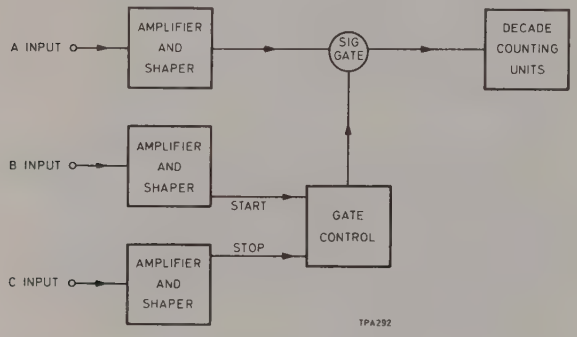


Fig. 2.8 Functional diagram: A/B—C

Fig. 2.8 shows a simplified functional diagram of the instrument in this operating mode. The 'Start' signal is applied to the B Input, opening the signal gate and allowing pulses derived from the events applied to the A input to pass to the decade counting units. These pulses are counted by the D. C. U. 's until the gate is closed by the 'Stop' signal, applied to the C Input.

Operating procedure

Set the controls as follows : -

(1) FUNCTION switch to FREQ A.

(7) TIME BASE switch to the desired position.

(4) GATE switch to AUTO.

(3) MEMORY switch to OFF.

(6) DISPLAY control for a short display time.

(9) A ATTENUATOR to X256 for TM 7557A, or
(10) X100 for TM 8267, and A TRIGGER LEVEL* control to centre.

(11) A SLOPE* switch to the required slope.

(8) Apply the signal to be measured to the A Input connector.

CAUTION

On maximum attenuator setting input must not exceed 500 V p–p for TM 7557A or 100V r.m.s. for TM 8267

(10) Rotate the A TRIGGER LEVEL* control until the instrument starts counting and the readout is consistent. If counting does not
(9) start, rotate the A ATTENUATOR switch, one position at a time, until the trigger level can be adjusted to give a consistent readout.

(1) Set the FUNCTION switch to PER B.

* Not applicable to TM 8267 (110 Mc/s Range Unit).

⑬ Set the B ATTENUATOR switch to X256 and
⑭ B TRIGGER LEVEL to centre.

⑫ Apply the 'Start' signal to the B Input connector.

⑮ Set the B SLOPE switch to the required slope.

⑭ Rotate the B TRIGGER LEVEL control until the instrument starts counting and repeated readouts are consistent. If readout is erratic,
⑬ rotate the B ATTENUATOR switch, one position at a time, until the trigger level can be adjusted to give a consistent readout.

⑰ Set the C ATTENUATOR switch to X256 and
⑱ C TRIGGER LEVEL control to the centre.

⑯ Apply the 'Stop' signal to the C Input connector.

⑲ Set the C SLOPE switch to the required slope.

① Set the FUNCTION switch to TIME B⟶C.

⑱ Rotate the C TRIGGER LEVEL control until the instrument stops counting, and repeated readouts are consistent. If readout is erratic,
⑰ rotate the C ATTENUATOR switch, one position at a time, until the trigger level can be adjusted to give a consistent readout.

① Set the FUNCTION switch to A/B⟶C and observe readout.

③ Set the MEMORY switch and DISPLAY control
⑥ for desired display mode.

2.12 TOTALIZING MEASUREMENT

Functional description

With the FUNCTION switch in the COUNT A position, the instrument totalizes the input. Fig. 2.9 shows a simplified functional diagram of the instrument in this operating mode. The input is applied to the A Input connector. The decade counting units count the total number of cycles that occur while the signal gate is open. The gate is opened and closed manually, by setting the GATE switch to OPEN and then to AUTO.

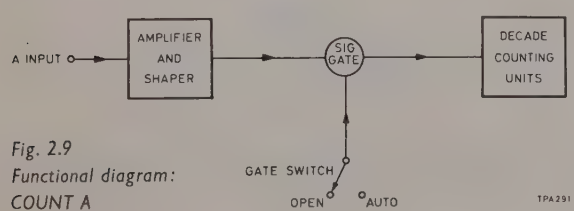


Fig. 2.9 Functional diagram: COUNT A

Operating procedure

Set the controls as follows :-

① FUNCTION switch to FREQ A.

⑦ TIME BASE switch to the desired position.

④ GATE switch to AUTO.

③ MEMORY switch to OFF.

⑥ DISPLAY control for a short display time.

⑨ A ATTENUATOR to X256 for TM 7557A,
⑩ or X100 for TM 8267, and A TRIGGER LEVEL* control to centre.

⑪ A SLOPE* switch to the required slope.

⑧ Apply the signal to be counted to the A Input connector.

CAUTION

On maximum attenuator setting input must not exceed 500 V p–p for TM 7557A or 100V r.m.s. for TM 8267

⑩ Rotate the A TRIGGER LEVEL* control until the instrument starts counting and the readout is consistent. If counting does not
⑨ start, rotate the A ATTENUATOR switch, one position at a time, until the trigger level can be adjusted to give a consistent readout.

① Set the FUNCTION switch to COUNT A.

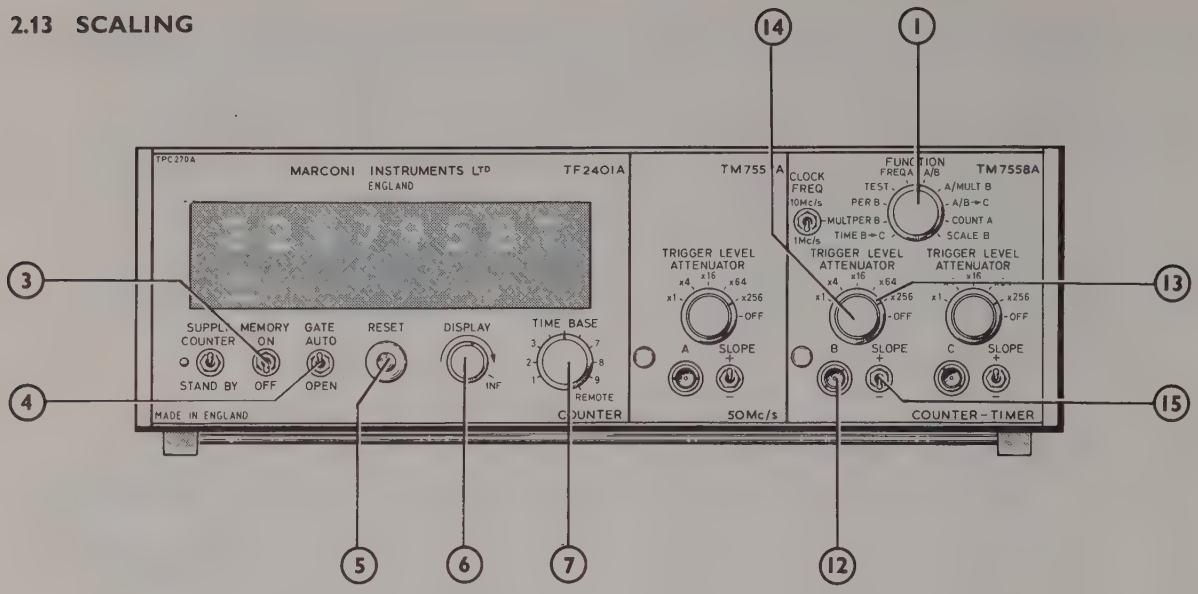
④ Set the GATE switch to OPEN to start totalizing.

④ Set the GATE switch to AUTO to stop totalizing.

⑤ After completion of the measurement, press the RESET button to erase readout. The results of two or more measurements may be added by not pressing the RESET button after the completion of each measurement.

* Not applicable to TM 8267 (110 Mc/s Range Unit).

2.13 SCALING



Functional description

With the FUNCTION switch set to SCALE B the instrument divides the input by a selected factor, and totalizes the result.

Fig. 2.10 shows a simplified functional diagram of the instrument in this operating mode. The time base divides the number of cycles of the input signal, applied to the B Input connector, by a selected factor, and routes tham through the signal gate to the decade counting units. The D.C.U.'s count the scaled-down number of cycles while the gate is open. The signal gate is opened and closed manually by setting the GATE switch to OPEN and then to AUTO.

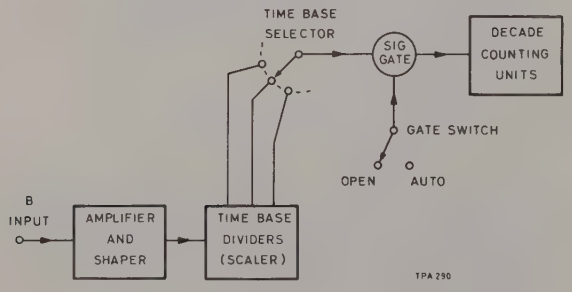


Fig. 2.10 Functional diagram: SCALE B

Operating procedure

Set the controls as follows :-

(1) FUNCTION switch to PER B.

(7) TIME BASE switch to the desired scaling factor.

(4) GATE switch to AUTO.

(3) MEMORY switch to OFF.

(6) DISPLAY control for a short display time.

(13) B ATTENUATOR switch to X256 and B
(14) TRIGGER LEVEL control to centre.

(12) Apply the signal to be counted to the B Input connector.

CAUTION

Inputs must not exceed 500V p-p on maximum attenuator setting

(15) Set the B SLOPE switch to the required slope.

⑭ Rotate the B TRIGGER LEVEL control until the instrument starts counting, and repeated readouts are consistent. If readout is erratic,

⑬ rotate the B ATTENUATOR switch, one position at a time, until the trigger level can be adjusted to give a consistent readout.

① Set the FUNCTION switch to SCALE B.

④ Set the GATE switch to OPEN to start the totalizing.

④ Set the GATE switch to AUTO to stop the totalizing.

⑤ After completion of the measurement, press the RESET button to erase readout. The results of two or more measurements may be added by not pressing the RESET button after completion of each measurement.

To obtain the correct pulse count, multiply the readout by the factor originally selected.

Section 3

Technical description

3.1 TM 7771: B and C AMPLIFIERS

The two amplifiers are identical. Two supply rails are used, +6 V and -6 V, produced by Zener diodes MR8 and MR9. By producing the supplies locally from the +20 V and -20 V lines, the interaction between circuits is kept to a minimum.

VT1 is a field effect transistor, designed into a source follower to maintain the high input impedance of the B and C channels at frequencies from 100 kc/s to d.c. The two transistor stage (VT1, VT2) has good temperature stability since the negative temperature coefficient of the FET tends to balance the positive temperature coefficient of the p-n-p transistor.

Capacitor C2 couples the input straight into VT2 at frequencies above 100 kc/s.

VT4 and VT5 form a long-tailed pair acting as a phase splitter. The current gains are matched to within 5% and RV2 is set to give equal collector potentials for no input signal.

The slope switch selects the output of VT4 or VT5 to drive the output stage. The principle of operation is that the unwanted output point, either junction R21-R31 or R22-R32, is connected to earth leaving the other point to feed the OR gate MR6-MR7. The output stage is a tunnel diode and transistor fast switching circuit, VT8-MR2, feeding into a complementary pair of emitter followers, VT10 and VT11.

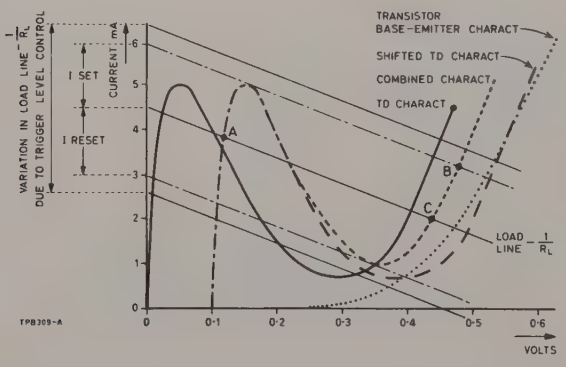


Fig. 3.1 Level detector characteristics

The switching circuit produces a very fast positive going edge from the slower, negative going input. The curves in Fig. 3.1 show typical characteristics and combined characteristics of the two active elements. The position of the load line, -1/RL, is a function of the trigger level control.

An input signal will turn on VT8, which then couples the trigger level potentiometer to +6 V. The circuit shown in Fig. 3.2 now becomes effective.

Biasing is arranged such that with the trigger level control in the central position the load line approximately bisects the peak to valley distance; i.e., for constant current input drive minimum set and reset currents operate the switch. These values correspond to the minimum input drive to the counter for stable operation. Increased input drives enable selection of the trigger point by varying the load-line position with the trigger level control. At the extreme positions of the load line, a large input drive is required to provide sufficient set or reset current drive.

The low impedance output stage is necessary to produce fast pulses into the screened output leads.

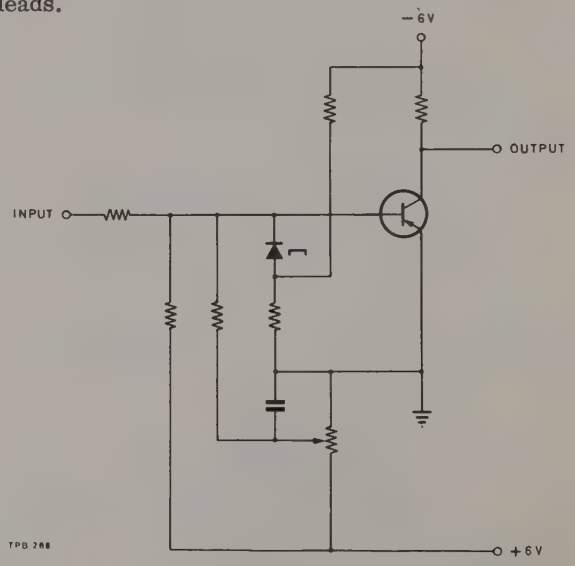


Fig. 3.2 Trigger circuit

Section 4

Maintenance notes

4.1 GENERAL

This section of the manual is intended as a general guide to the servicing of the unit. In case of difficulties which cannot be resolved with the aid of this book, please contact our Service Division at the address on the rear cover, or your nearest Marconi Instruments representative. Always mention the type number and serial number of your unit.

Power supplies and non-critical signals are connected to the Counter by a 36-way Amphenol plug. Snap-on BNC plugs and sockets connect the more critical signals.

If it is found necessary to check the performance of the unit, this should be done in conjunction with a TF 2401A and a Range unit, both of which are working correctly.

4.2 SETTING UP THE B AND C AMPLIFIERS

Test gear required :

Voltmeter : Avo model 8.

Signal generator : To supply frequency in range of Counter; Marconi Instruments Type TF 144H Series.

(a) Connect the voltmeter between the collector of VT4 and the collector of VT5. Adjust RV2 until the the meter reads zero volts.

(b) Apply an input signal and check that a similar waveform is obtained at the output of the amplifier, for either slope, at the same trigger level setting. A difference in mark/space ratio, or change in TRIGGER LEVEL setting indicates incorrect setting up of the amplifiers.

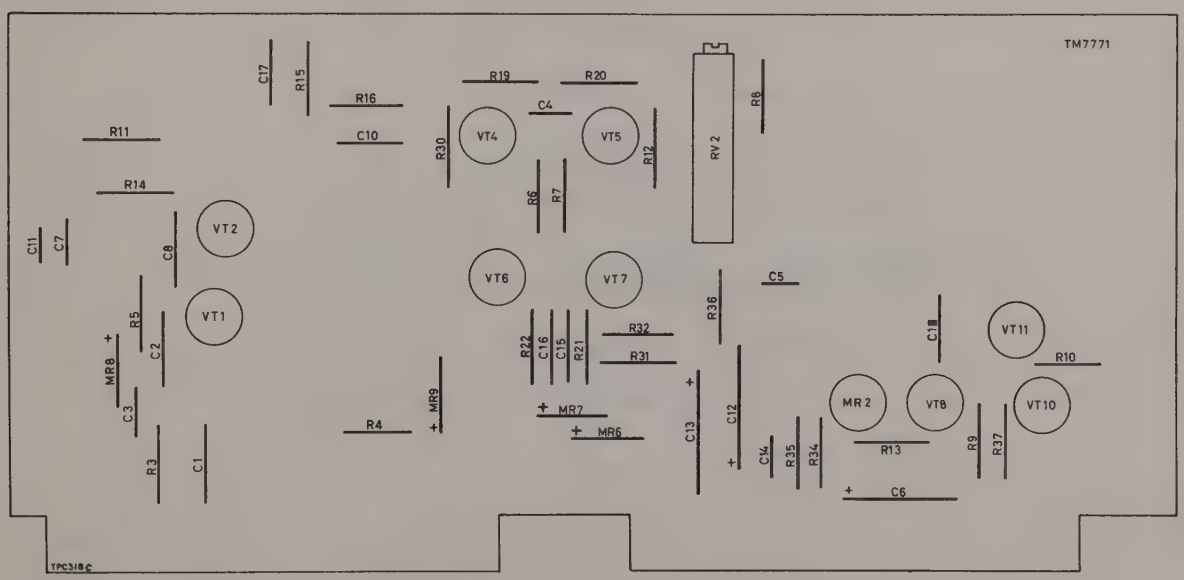


Fig. 4.1 10 Mc/s Amplifier TM 7771

4.3 REPLACING TRANSISTORS

If it is necessary to replace VT4 or VT5 it must be remembered that the of these transistors must match to within 5%.

4.4 UNITS INDICATOR CHECK

A check can be made that all indicator lamps are functioning, and that correct units are being selected for any given function by rotating the TIME BASE switch through all its positions for each position on the FUNCTION switch.

The table shows what the selected units should be. The figure to the right of the unit indicates the position of the decimal point, read from the right, e.g., mS-2 indicates milliseconds as the units and the decimal point placed thus 0000000.0

FUNCTION	REMOTE	TIME BASE SWITCH POSITION T9	T8	T7	T6	T5	T4	T3	T2	T1
Time B → C	ALL LAMPS OFF	SEC-1	SEC-2	SEC-3	mS-1	mS-2	mS-3	μS-1	μS-2	μS-3
Mult Per B		10^8μS	10^7μS	10^6μS	10^5μS	10^4μS	10^3μS	10^2μS	10^1μS	
Per B		SEC-1	SEC-2	SEC-3	mS-1	mS-2	mS-3	μS-1	μS-2	μS-3
Test		Mc/s-1	Mc/s-2	Mc/s-3	kc/s-1	kc/s-2	kc/s-3	c/s-1	c/s-2	c/s-3
Freq A		Mc/s-1	Mc/s-2	Mc/s-3	kc/s-1	kc/s-2	kc/s3	c/s-1	c/s-2	c/s-3
A/B		ALL LAMPS OFF								
A/Mult B		10^8	10^7	10^6	10^5	10^4	10^3	10^2	10^1	
A/B → C		ALL LAMPS OFF								
Count A		ALL LAMPS OFF								
Scale B		10^8	10^7	10^6	10^5	10^4	10^3	10^2	10^1	

NOTE: On Mult PER B, CLOCK switch at 10 Mc/s lights second decimal point lamp; at 1 Mc/s, first decimal point.

Section 5

Logic tables

Introduction

The following tables are relevant to the instrument as a whole, i.e., with a Range unit and this Function unit fitted.

Table 1 defines the function symbols; i.e., each FUNCTION switch position is given a reference (F_1, F_2, etc.).

Table 2 defines the select signals. The select signals are gating signals (see logic diagram in the Range unit manual) which are generated by the FUNCTION switch on this unit and the TIME BASE switch on the main instrument.

Table 3 shows which select signals are active for any given position of the FUNCTION switch.

Table 4 shows which select signals are generated by the various combinations of FUNCTION and TIME BASE switches settings.

TABLE 1

FUNCTIONS

Function Switch Position Symbol	*Label on Front Panel*	*Description*
F_1	TIME B⟶C	Time Interval Measurement
F_2	MULT PER B	Multiple Period Measurement
F_3	PER B	Period Measurement
F_4	TEST	Self Check
F_5	FREQ A	Frequency Measurement
F_6	A/B	Frequency Ratio Measurement
F_7	A/MULT B	Multiple Frequency Ratio Measurement
F_8	A/B⟶C	Measurement of Events During a Selected Time Interval
F_9	COUNT A	Totalizing Measurement
F_{10}	SCALE B	Scaling of Input Signal

TABLE 2

SELECT SIGNAL SYMBOLS

Select Symbol	Label	Description
J_1	1 Mc/s CLOCK SEL	Selects 1 Mc/s standard for Multiple Period measurements.
J_2	10 Mc/s CLOCK SEL	Selects 10 Mc/s standard for Multiple Period measurements.
S_1	'A' AMPLIFIER SEL	Selects output of 'A' amplifier to be counted.
S_2	TIME BASE SIGNAL SEL	Selects output of time base to be counted.
S_3		Not used.
S_4	TIME BASE CONTROL SEL	Selects output of time base to open and close count gate.
S_5	'B' START SEL	Selects output of 'B' amplifier to open count gate.
S_6	'B' STOP SEL	Selects output of 'B' amplifier to close count gate.
S_7	'C' STOP SEL	Selects output of 'C' amplifier to close count gate.
S_8	REF FREQ TIME BASE INPUT SEL	Selects REF FREQ input to time base.
$\overline{S}_9$	MULT PER MODE TIME BASE OUT SEL	Prevents selection of output of 'B' amplifier as input to time base, and prevents selection of output appropriate for MULT PER mode.
S_{10}	AUX INPUT SEL	Selects output of 'B' amplifier to be counted.
$\overline{S}_{11}$	FREQ MODE TIME BASE OUT SEL	Prevents selection of time base output appropriate for FREQ mode.
$\overline{S}_{12}$	PER MODE TIME BASE OUT SEL	Prevents selection of time base output appropriate for PER mode.
S_{13}	10 Mc/s SIGNAL SEL	Selects 10 Mc/s signal to be counted.
S_{14}	1 Mc/s SIGNAL SEL	Selects 1 Mc/s signal to be counted.
S_{15}	100 Mc/s SIGNAL SEL	Selects 100 Mc/s signal to be counted.

TABLE 3

LOGIC SIGNAL CHART (Function v Select Signal)

	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	$\overline{S}_9$	S_{10}	$\overline{S}_{11}$	$\overline{S}_{12}$	S_{13}	S_{14}	S_{15}
F_1		x	-		x		x	x	x		x		T_{2x}	T_{3x}	T_{1x}
F_2			-	x							x	x	J_{2x}	J_{1x}	
F_3		x	-		x	x		x	x		x		T_{2x}	T_{3x}	T_{1x}
F_4			-	x				x	x			x	x		
F_5	x		-	x				x	x			x			
F_6	x		-		x	x			x		x	x			
F_7	x		-	x							x	x			
F_8	x		-		x		x		x		x	x			
F_9	x		-						x		x	x			
F_{10}		x	-								x	x			

NOTES : x = -6 V; T_{1x} = -6 V only when time base switch at position 1

T_{2x} = -6 V only when time base switch at position 2

T_{3x} = -6 V only when time base switch at position 3

J_{1x} = -6 V only when CLOCK switch set to 1 Mc/s.

J_{2x} = -6 V only when CLOCK switch set to 10 Mc/s.

TABLE 4

LOGIC EQUATIONS

$F_1 \cdot (T_4 + T_5 + \ldots . T_9)$	$= S_2 \cdot S_5 \cdot S_7 \cdot S_8 \cdot \overline{S}_9 \cdot \overline{S}_{11}$
$F_1 \cdot T_3$	$= S_2 \cdot S_5 \cdot S_7 \cdot S_8 \cdot \overline{S}_9 \cdot \overline{S}_{11} \cdot S_{14}$
$F_1 \cdot T_2$	$= S_2 \cdot S_5 \cdot S_7 \cdot S_8 \cdot \overline{S}_9 \cdot \overline{S}_{11} \cdot S_{13}$
$*F_1 \cdot T_1$	$= S_2 \cdot S_5 \cdot S_7 \cdot S_8 \cdot \overline{S}_9 \cdot \overline{S}_{11} \cdot S_{15}$
$F_2 \cdot J_1 (T_2 + T_3 + \ldots . T_9)$	$= S_4 \cdot \overline{S}_{11} \cdot S_{12} \cdot S_{14}$
$F_2 \cdot J_2 (T_2 + T_3 + \ldots . T_9)$	$= S_4 \cdot \overline{S}_{11} \cdot S_{12} \cdot S_{13}$
$F_3 \cdot (T_4 + T_5 + \ldots . T_9)$	$= S_2 \cdot S_5 \cdot S_6 \cdot S_8 \cdot \overline{S}_9 \cdot \overline{S}_{11}$
$F_3 \cdot T_3$	$= S_2 \cdot S_5 \cdot S_6 \cdot S_8 \cdot \overline{S}_9 \cdot \overline{S}_{11} \cdot S_{14}$
$F_3 \cdot T_2$	$= S_2 \cdot S_5 \cdot S_6 \cdot S_8 \cdot \overline{S}_9 \cdot \overline{S}_{11} \cdot S_{13}$
$*F_3 \cdot T_1$	$= S_2 \cdot S_5 \cdot S_6 \cdot S_8 \cdot \overline{S}_9 \cdot \overline{S}_{11} \cdot S_{15}$
$F_4 \cdot (T_1 + T_2 + \ldots . T_9)$	$= S_4 \cdot S_8 \cdot \overline{S}_9 \cdot \overline{S}_{12} \cdot S_{13}$
$F_5 \cdot (T_1 + T_2 + \ldots . T_9)$	$= S_1 \cdot S_4 \cdot S_8 \cdot \overline{S}_9 \cdot \overline{S}_{12}$
$F_6 \cdot (T_1 + T_2 + \ldots . T_9)$	$= S_1 \cdot S_5 \cdot S_6 \cdot \overline{S}_9 \cdot \overline{S}_{11} \cdot \overline{S}_{12}$
$F_7 \cdot (T_2 + T_3 + \ldots . T_9)$	$= S_1 \cdot S_4 \cdot \overline{S}_{11} \cdot \overline{S}_{12}$
$F_8 \cdot (T_1 + T_2 + \ldots . T_9)$	$= S_1 \cdot S_5 \cdot S_7 \cdot \overline{S}_9 \cdot \overline{S}_{11} \cdot \overline{S}_{12}$
$F_9 \cdot (T_1 + T_2 + \ldots . T_9)$	$= S_1 \cdot \overline{S}_9 \cdot \overline{S}_{11} \cdot \overline{S}_{12}$
$F_{10} \cdot (T_2 + T_3 + T_4 + \ldots . T_9)$	$= S_2 \cdot \overline{S}_{11} \cdot \overline{S}_{12}$

NOTES :

* equation calls for 100 Mc/s, from Range unit, which is not available from TM 7557A.
$T_1 \longrightarrow T_9$; time base switch positions.

Example :

The first equation may be stated thus; with the FUNCTION switch set to TIME B→C, and the TIME BASE switch set to position 4 or 5 or 6 etc. (i.e., 10 c/s or 100 c/s ....), Select signals S_2 and S_5 and S_7 and S_8 and $\overline{S}_9$ and $\overline{S}_{11}$ are produced, (see Table 2).

Section 6

Replaceable parts

Introduction

This section lists replaceable parts in alphabetical order of their circuit reference, with miscellaneous parts at the end of the list. A separate parts list is given for each circuit diagram. The following abbreviations are used:

Carb	:	carbon
Cer	:	ceramic
DPDT	:	double pole, double throw
Elec	:	electrolytic
G	:	conductance
Min	:	minimum
Plas	:	plastic
Pos	:	position
SPST	:	single pole, single throw
Var	:	variable
WW	:	wire wound
*	:	selected during test; nominal value listed

Note: Throughout the lists resistor wattages are referred to 70°C unless otherwise stated.

Ordering

When ordering replacement parts address the order to our Service Division. Specify the following information for each part required.

1) Type and serial number of instrument
2) Board title and TM number
3) Circuit reference
4) Description
5) M.I. code number

If a part is not listed, state its function, location and description when ordering.

Semiconductor types

The M.I. code listed against each diode or transistor refers, generally, to more than one type of semiconductor. These types are listed below against the M.I. code number.

DIODES

90441:	CMC4300164;	1N759A
90442:	CMC4300165;	1N753A
90443:	CMC4300172;	1N718A; HS2150
90444:	CMC4300178;	1N708A; 1N752A; 1S7056A
90445:	CMC4300179;	EVR20B; 1R203
91003:	CMC4300120;	1N34A/G; 1N34A
91004:	CMC4300141;	S3237G
91005:	CMC4300142;	1N458
91006:	CMC4300158;	1N3063; U16003
91007:	CMC4300160;	S555G; 1N995; HD1870
92003:	CMC4300149;	1N2069; 1N2069A; CER68C
92004:	CMC4300150;	CER71A
92005:	CMC4300161;	SOD100D
93003:	CMC4300169;	1N3562; LT2026
97002:	CMC4906078;	2N1595

TRANSISTORS

94003:	CMC4906075;	2N1241
95008:	CMC4906009;	2N404
95010:	CMC4906041;	SM644
95011:	CMC4906046;	SA636; 2N2001
95012:	CMC4906047;	2N1303
95013:	CMC4906049;	SP1685; 2N669
95014:	CMC4906052;	2N1038; CP1213
95015:	CMC4906060;	SM2034; 2N976
95016:	CMC4906065;	SM2035; SM642
95018:	CMC4906077;	SP1686; 2N1544
95511:	CMC4906038;	2N708; S5900; U16004
95512:	CMC4906043;	SM4998; U16005
95513:	CMC4906045;	2N709; U16006
95514:	CMC4906063;	U16007; 2N1990S; SM2128
95515:	CMC4906071;	SM5902; U16008; CET247
95516:	CMC4906072;	U16009; 2N2369; CET248
95517:	CMC4906073;	SM5901; U16010; CET249
95519:	2N2369S;	U16011
96501:	CMC4906048;	2N1302
97001:	CMC4906076;	W112; 2N2386

Chassis

Circuit reference	Description	M.I. code
CAPACITORS		
C101	Cer 56pF ±5% 750V	26324-851
C102	Cer 68pF ±2% 750V	26324-868
C103	Plas 390pF ±5% 125V	26516-388
C104	Plas 0.0015μF ±2% 125V	26516-524
C105	Paper 0.004μF ±10% 250V	26174-137
C108	Cer 0.1μF +50% -25% 25V	26383-031
C109	Cer 0.1μF +50% -25% 25V	26383-031
C110	Cer 0.1μF +50% -25% 12V	26383-029
C111	Plas 47pF ±2pF 350V	26516-167
PLUGS		
PL101	50 way	23435-421
PL132	Coaxial (B output)	23443-020
PL133	Coaxial (C output)	23443-020
RESISTORS		
R101	Carb 750kΩ ±5% ½W	24010-020
R102	Carb 270kΩ ±5% ¼W	24332-746
R103	Carb 47kΩ ±5% ¼W	24332-726
R104	Carb 12kΩ ±5% ¼W	24332-712
R105	Carb 3.9kΩ ±5% ¼W	24332-696
R106	Carb 200Ω ±5% 1W	24010-005
R107	Carb 200Ω ±5% 1W	24010-005
R108	Carb 200Ω ±5% 1W	24010-005
R109	Carb 200Ω ±5% 1W	24010-005

Circuit reference	Description	M.I. code
RV201	Special Var 1kΩ TRIGGER LEVEL (with S208)	44324-715
SOCKETS		
SK202	Coaxial	23443-448
SK203	Coaxial	23443-448
SWITCHES		
S208	6 pos (with RV201) ATTENUATOR	44324-715
S209	10 pos FUNCTION	44326-022
S210	SPST SLOPE B	23462-252
S211	SPST SLOPE C	23462-252
S212	DPDT CLOCK FREQ	23462-258
KNOBS		
	TRIGGER LEVEL 11/16" dia (Red)	41141-601
	FUNCTION 1" (with ring)	41142-704
	ATTENUATOR 1"	41141-304

For symbols and abbreviations see introduction to this section

10 Mc/s Amplifier: TM 7771

Circuit reference		Description	M.I. code
CAPACITORS			
C1	Plas	82pF ±2pF 125V	26516-222
C2	Plas	20pF ±2pF 350V	26516-077
C3	Cer	0.1μF +50% -25% 12V	26383-029
C4	Plas	180pF ±5% 350V	26516-307
C5	Plas	390pF ±5% 125V	26516-388
C6	Elec	2μF +100% -20% 25V	26414-109
C7	Cer	0.1μF +50% -25% 12V	26383-029
C8	Plas	20pF ±2pF 350V	26516-077
C10	Plas	180pF ±5% 350V	26516-307
C11	Cer	0.1μF +50% -25% 12V	26383-029
C12	Elec	2μF +100% -20% 25V	26414-109
C13	Elec	2μF +100% -20% 25V	26414-109
C14	Cer	0.01μF +80% -20% 100V	26383-055
C15	Plas	200pF ±2% 125V	26516-315
C16	Plas	200pF ±2% 125V	26516-315
C17	Plas	150pF ±2% 125V	26516-287
C18	Plas	100pF ±2pF 125V	26516-241
DIODES			
MR2	Tunnel diode		MIP 93003
MR6	Silicon planar		MIP 91006
MR7	Silicon planar		MIP 91006
MR8	5.6V Zener		MIP 90444
MR9	5.6V Zener		MIP 90444
RV2	WW	1kΩ ±10% ¼W variable	25886-195
RESISTORS			
R3	Carb	100kΩ ±5% 1/10W	24331-335
R4	Carb	1MΩ ±5% 1/10W	24331-366
R5	Carb	1kΩ ±5% 1/10W	24331-280
R6	Carb	510Ω ±5% ¼W	24332-071
R7	Carb	510Ω ±5% ¼W	24332-071
R8	Carb	750Ω ±5% 1/10W	24331-277
R9	Carb	330Ω ±5% ¼W	24332-063
R10	Carb	56Ω ±5% ¼W	24332-040
R11	Carb	30kΩ ±5% 1/10W	24331-321
R12	Carb	560Ω ±5% 1/10W	24331-272
R13	Carb	560Ω ±5% 1/10W	24331-272
R14	Carb	150Ω ±5% ¼W	24332-054
R15	Carb	820Ω ±5% 1/10W	24331-278
R16	Carb	560Ω ±5% 1/10W	24331-272
R19	Carb	10Ω ±5% 1/10W	24331-220
R20	Carb	10Ω ±5% 1/10W	24331-220
R21	Carb	300Ω ±5% ¼W	24332-062
R22	Carb	300Ω ±5% ¼W	24332-062
R30	Carb	1.2kΩ ±5% ¼W	24332-082
R31	Carb	330Ω ±5% ¼W	24332-063
R32	Carb	330Ω ±5% ¼W	24332-063
R34	Carb	10Ω ±5% 1/10W	24331-220
R35	Carb	470Ω ±5% 1/10W	24331-269
R36	Carb	100Ω ±5% 1/10W	24331-250
R37	Carb	1kΩ ±5% 1/10W	24331-280
TRANSISTORS			
VT1	Field effect		MIP 97001
VT2	High speed		MIP 95015
VT4	High speed, planar		MIP 95517
VT5	High speed, planar		MIP 95517
VT6	High frequency, planar		MIP 95515
VT7	High frequency, planar		MIP 95515
VT8	High speed, epitaxial		MIP 95010
VT10	High speed, planar		MIP 95516
VT11	High speed, epitaxial		MIP 95010

For symbols and abbreviations see introduction to this section

Section 7

Circuit diagrams

Circuit notes

1. COMPONENT VALUES

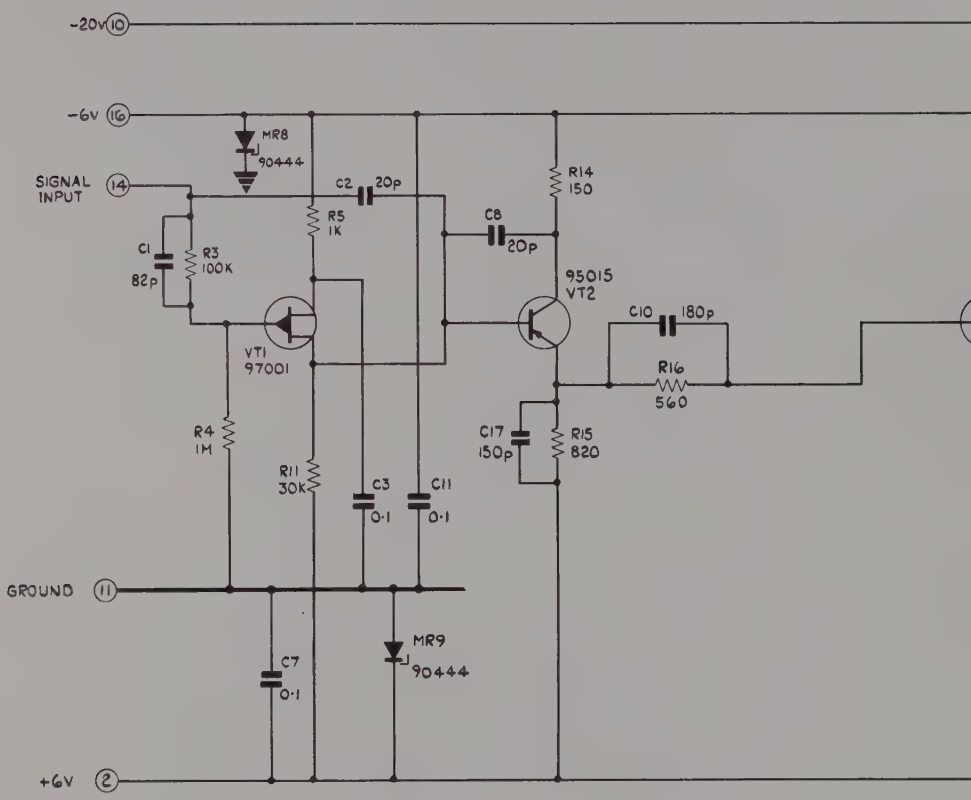
Resistors : No suffix = ohms. k = kilohms. M = megohms.
Capacitors : No suffix = microfarads. p = picofarads.
* value selected during test; nominal value shown.

2. SYMBOLS

+► arrow indicates clockwise rotation of knob.

Numbers adjacent to diodes and transistors refer to MIP specification.

○ indicates pins on socket to front of counter.
□ indicates pins on socket to rear of counter.


-20V 10
-6V 16
MR8
90444
SIGNAL INPUT 14
C2 20p
R14 150
R5 1K
C8 20p
C1 82p
R3 100K
95015 VT2
C10 180p
VT1 97001
R16 560
R4 1M
C17 150p
R15 820
R11 30K
C3 0·1
C11 0·1
GROUND 11
MR9
90444
C7 0·1
+6V 2

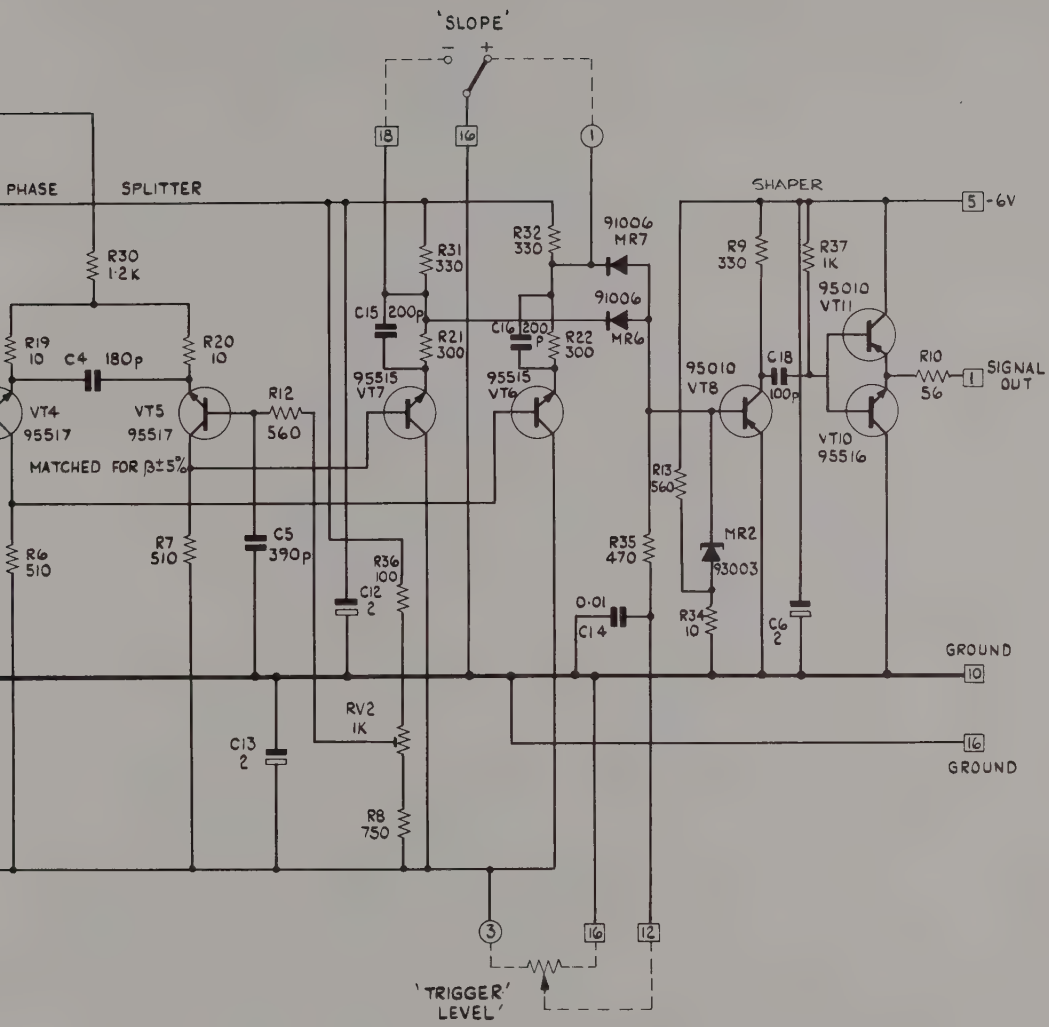
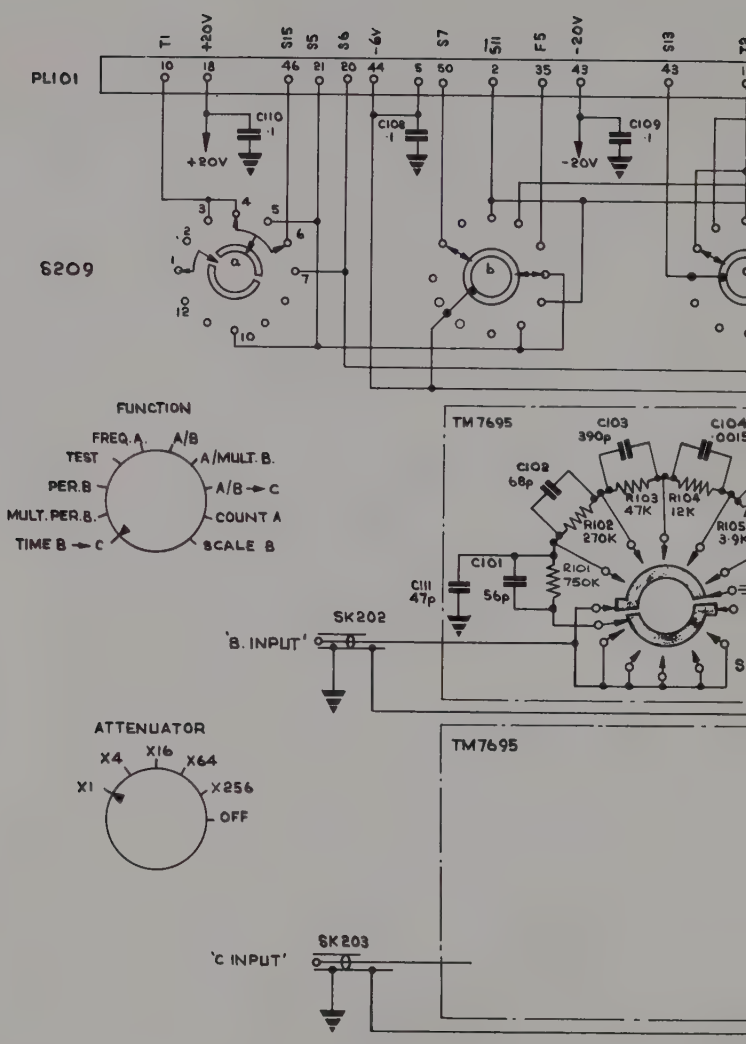


Fig. 7.1 10 Mc/s Amplifier TM 7771


PL101
T1
+20V
S15
S5
S6
-6V
S7
S11
F5
-20V
S13
10
18
46
21
20
44
5
50
2
35
43
43
C110 .1
+20V
C108 .1
C109 .1
-20V
S209
FUNCTION
FREQ. A.
A/B
TEST
A/MULT. B.
PER. B
A/B → C
MULT. PER. B.
COUNT A
TIME B → C
SCALE B
TM 7695
C103 390p
C104 .0015
C102 68p
R103 47K
R104 12K
R102 270K
R105 3.9K
C101 56p
R101 750K
C111 47p
SK202
'B. INPUT'
ATTENUATOR
X4
X16
X64
X1
X256
OFF
TM7695
SK203
'C INPUT'

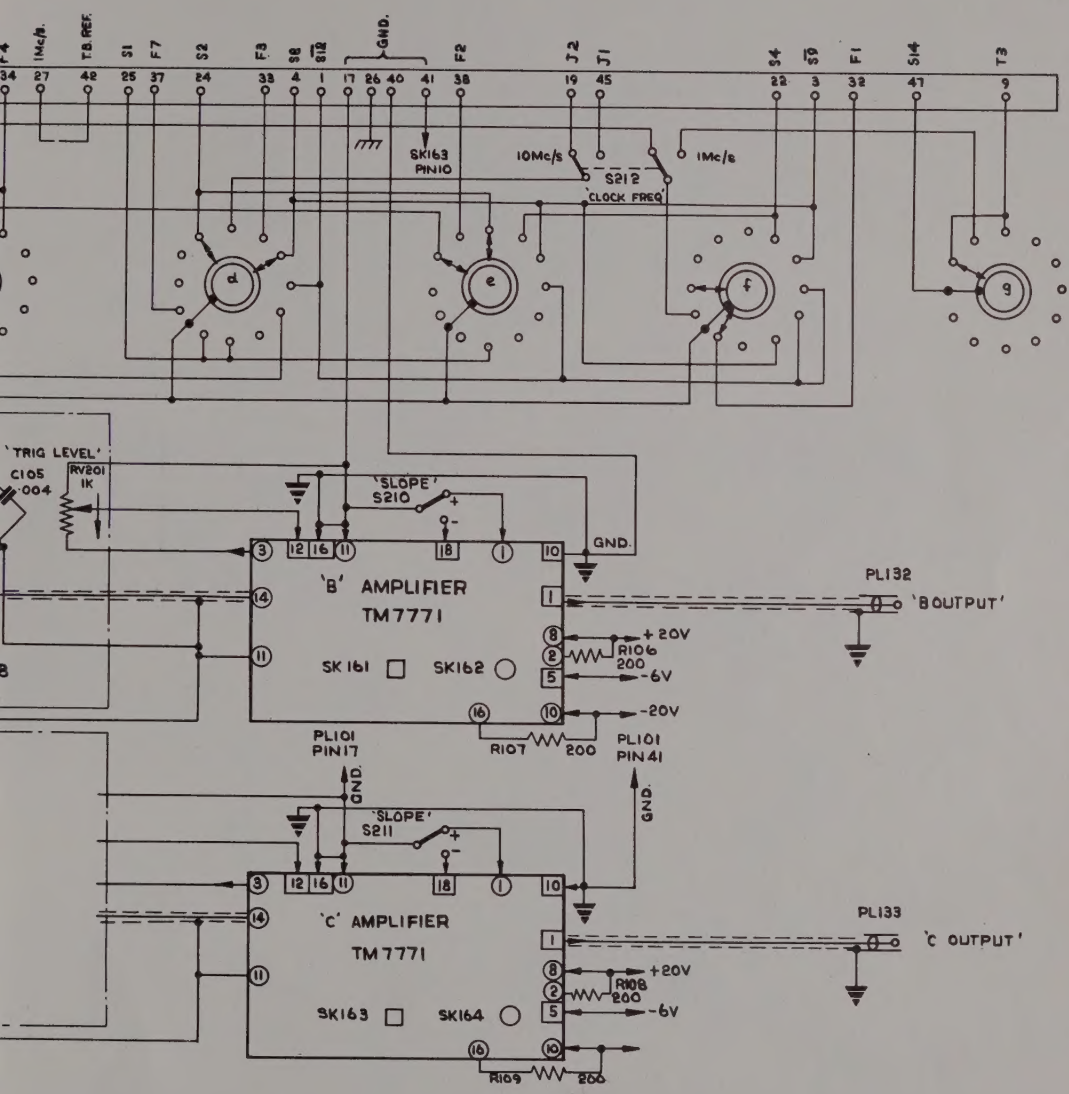


Fig. 7.2 Interconnecting diagram

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